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ORAL ADMINISTRATION OF TILETAMINE/ZOLAZEPAM FOR THE IMMOBILIZATION OF THE COMMON BUZZARD (*BUTEO BUTEO*)

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ABSTRACT.—The purpose of this study was to test the efficacy of oral administration of tiletamine/zolazepam in a bait for immobilizing Common Buzzards (*Buteo buteo*) ($N = 20$). Two different dosages and two different methods of administration were compared. A dosage of 80 mg/kg was sufficient in most birds to enable safe handling after 30–60 min, whereas the majority of animals receiving 40 mg/kg still showed defensive reflexes. Birds receiving the drug in a powder form reached the deepest stage of anaesthesia after 30 min, whereas birds receiving a solution reached this stage significantly later, but not before 60 min. When the prepared bait with 80 mg/kg powder was stored for 7 or 14 hr, respectively, effectiveness of immobilization was significantly decreased compared to bait which was administered immediately after preparation.

KEY WORDS: *Common buzzard*; Buteo buteo; *tiletamine*; *zolazepam*; *immobilization*; *oral administration*; *capture*; *Zoletil*.

Administración oral de Tiletamina/zolazepam para la inmovilización de *Buteo buteo*

RESUMEN.—El propósito de este estudio fue el de administrar oralmente tiletamina/zolazepam en un cebo para la inmovilización de *Buteo buteo* ($N = 20$). Dos dosificaciones y dos métodos diferentes de administración fueron comparados. Una dosis de 80 mg/kg fue suficiente en la mayoría de las aves para garantizar una manipulación segura después de 30–60 minutos, mientras que la mayoría de los animales que recibieron 40 mg/kg tenían reflejos para defenderse. Las aves que recibieron la droga en forma de polvo alcanzaron los estados más profundos de anestesia después de 30 minutos, mientras que las que recibieron en solución alcanzaron este estado significativamente mas tarde, no antes de 60 minutos. Cuando el cebo con 80 mg/kg de polvo fue almacenado durante 7 o 14 horas respectivamente, la efectividad de la inmovilización disminuyo significativamente comparada con el cebo suministrado inmediatamente después de la preparación.

[Traducción de César Márquez]

Raptors have to be captured in a number of different situations. Birds which escape from their aviary can be dangerous to man, especially if they are imprinted on humans. To prevent such individuals from being killed, they have to be caught immediately. For therapeutic reasons, injured or young birds which are not able to migrate have to be captured. For scientific investigations, wild birds have to be immobilized to be marked, measured, transported, or fitted with a transmitter. The well-known inhalation anaesthesia for birds with isoflurane (Hochleithner 1992) cannot be used for these purposes. Also, chemical immobilization via tele-injection (Wiesner 1998) with a blow pipe or narcotic rifle is not suitable for the capture of birds due to the possibility of producing serious injuries. Therefore, mechanical methods for capturing birds, especially nets or different types of snares, are still used. The stress for these animals is inevitable and escape attempts followed by injuries sometimes cannot be avoided. The oral administration of different narcotics with a prepared bait was tested in several avian species. Williams and Phillips (1972) tried to catch Rock Doves (*Columba livia*) using Tribromomethanol. The small safety margin of this drug resulted in a mortality rate between 2.9% and 40.6%. Alpha-chloralose, a chloral derivative of glucose (Crider and McDaniel 1967) seems to be suitable for the oral immobilization of Rock Doves (Woronecki et al. 1992, Woronecki and Dolbeer 1994, Belant and Seamans 1999), Wild Turkeys (*Meleagris gallopavo*) (Williams 1966), Marabou

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Storks (*Leptoptilos crumeniferus*) (Pomeroy and Woodford 1976), American Crows (*Corvus brachyrhynchos*) (Stouffer and Caccamise 1991), and Canada Geese (*Branta canadensis*) (Belant and Seamans 1997). Studies on the use of alpha-chloralose in raptors have not been reported. Ketamine, a dissociative anaesthetic, can be administered orally in birds and has a wide safety margin (Kösters and Jakoby 1987). This drug has been used successfully in the immobilization of raptors (Van Heerden et al. 1987) and, for instance, a Harris' Hawk (*Parabuteo unicinctus*) was immobilized with the oral administration of ketamine (Garner 1988). However, the use of ketamine alone in birds may lead to convulsions that can be prevented if it is used together with diazepam (Baronetzky-Mercier and Seidel 1995). The injection of a combination of ketamine and climazolam, a potent benzodiazepian derivative, was shown to be effective for the immobilization of Common Buzzards (*Buteo buteo*) (Gutzwiller et al. 1984). The objectives of our study were to assess the suitability of oral administration of tiletamine-zolazepam for the immobilization of Common Buzzards, to find the optimal dosage of different preparations, and to evaluate the loss of effectiveness with storage time of the bait. Tiletamine-zolazepam is an injectable anaesthetic combination which provides rapid and smooth induction of anaesthesia (Hui Chu Lin 1996) and has been shown to be effective and safe in many species including raptors (Schobert 1987).

MATERIALS AND METHODS

Animals. We obtained 20 buzzards for this study from the raptor rehabilitation center, Fuchsenbigl, Austria. Use of animals in this study followed the Austrian law on animal experiments (§ 8 BGBl.Nr. 501/1989, GZ 68.205/83-Pr/4/96). The raptors were housed in an aviary. Most of these birds had been found injured in the wild, and 18 of the birds were unable to fly. Birds were clinically examined before and after each immobilization, and neither age, sex, or a detailed health status of the animals was known. All the animals were not fed for 24 hr prior to the application of Zoletil® to create standardized conditions concerning resorption. For the oral application of the prepared meat the birds were manually restrained. Therefore, the animals were put into a paper box and the wings were held firmly against the body. To observe the induction time the birds were transfered into a separate aviary.

Drug and Preparation of the Bait. Zoletil® (Virbac, Carros, France) is a 1:1 combination of tiletamine and zolazepam. Tiletamine is a dissociative anaesthetic with a pharmacological activity similar to ketamine (Lin et al. 1993), but is more potent (Short et al. 1989). Zolazepam is a benzodiazepine agonist and in pharmacological activity comparable to diazepam (Loescher 1999). For handling the drug, the same precautions to avoid misuse or accidental intake by humans must be taken as for other commonly-used anaesthetics. Zoletil® comes as a freeze-dried powder suitable to adhere to different surfaces or to dissolve in solutions up to 33%. This combination is used for many domestic and exotic species (Schobert 1987). It was shown to be suitable to produce anaesthesia in buzzards via intramuscular injection (Trah 1990). Dosages for the oral administration of Zoletil® could not be found in the literature. For the oral application, the dry powder was scattered over a piece of rabbit meat or a 10% solution with sterile water was applied on the surface of the meat and allowed to dry for 20 min. For the experiments during phase three the prepared meat with Zoletil® was stored for 7 or 14 hr, respectively, at room temperature and daylight.

Study Design. *Phase one.* Test birds were randomly assigned into two groups. One group ($N = 10$) was fed meat sprinkled with 40 mg/kg of powdered Zoletil®, while the second group ($N = 10$) was fed meat covered with 40 mg/kg Zoletil® in a 10% solution of sterile water

Phase two. Four wk later we repeated the experiment with a dosage of 80 mg/kg. The birds were again randomly assigned into one of the two groups.

Phase three. Six mo later we repeated the experiment with a dosage of 80 mg/kg powdered Zoletil®, however, a pre-administration period of 7 hr for group one and 14 hr for group two was added. Again, the birds were randomly assigned into one of the two groups.

Assessment of Depth of Anaesthesia. The depth of anaesthesia was judged clinically. We used a modified version of the scale of Gutzwiller (1984): 0 = no effect; 1 = light sedation; 2 = moderate sedation, close approach not possible; 3 = strong sedation, birds able to be handled by experienced people; 4 = superficial anaesthesia, birds able to be handled by inexperienced people; 5 = deep anaesthesia.

All birds were checked 30, 60, and 90 min after application of Zoletil® anaesthesia. If approach to and handling of the buzzards were possible (stage 3), every check included assessment of heart and respiration rate. In buzzards which had reached stage 4, the palpebral reflex, corneal reflex, head position, and neck muscle tone were tested additionally. For birds in stage 5, the reflex-monitoring system of Korbel et al. (1997) was used. Following the last check, the birds were taken out of the aviary and put into a cardboard box where they spent the night, before they were returned to their common aviary. Recovering birds were checked every 30 min in the cardboard box until they returned to stage 0. No more than two animals were immobilized at the same time.

Statistics. To test for differences in anaesthesia depth we used a non-parametric analysis of variance for repeated measurements with time course of anaesthesia as the within-subjects factor and dose as well as preparation of Zoletil® as between-subjects factors (Zar 1984). Depth of anaesthesia values were transformed to ranks for analysis To test statistical differences in induction time between baits with different storage time we used two-tailed Mann-Whitney *U*-tests. Criterion for detection of statistically significant differences was $P \leq 0.05$.

Animals that died in association with the use of the

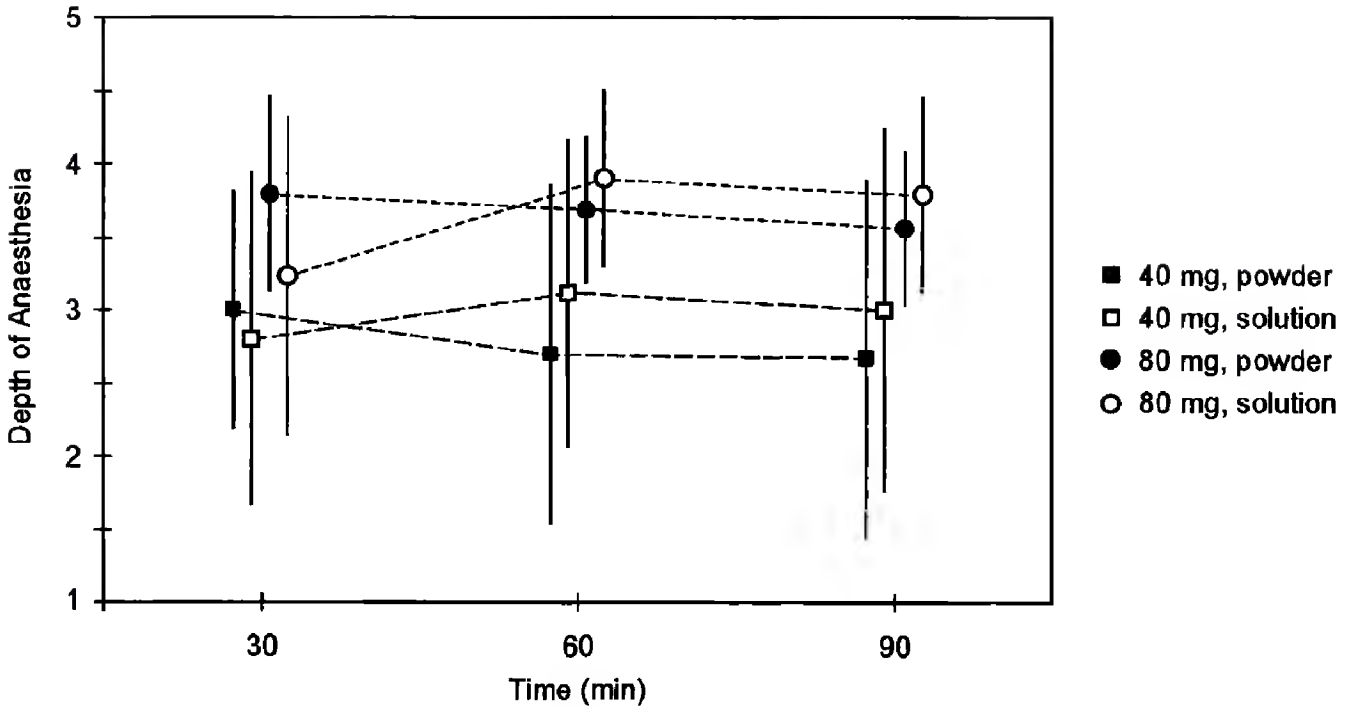

Figure 1. Depth of anaesthesia (mean ± SE) 30, 60, and 90 min after receiving oral Zoletil® (0 = no effect; 1 = light sedation; 2 = moderate sedation, close approach not possible; 3 = strong sedation, birds able to be handled by experienced people; 4 = superficial anaesthesia, birds able to be handled by inexperienced people; 5 = deep anaesthesia).

drugs were necropsied following standard protocols (Roffe et al. 1996). Necropsy was carried out by the Institute of Pathology at the University of Veterinary Medicine, Vienna, Austria.

RESULTS

The 20 animals receiving 40 mg/kg had significantly lower mean values of depth of anaesthesia than the animals receiving 80 mg/kg ($P < 0.02$). Fifteen out of 18 birds receiving 80 mg/kg (83%) reached stage 4, whereas only six out of 20 (30%) birds receiving 40 mg/kg achieved that stage. However, 17 out of 20 (85%) animals of that group reached at least stage 3 (Fig. 1).

The administration form had no overall effect on the depth of anaesthesia. However, the time course of anaesthesia depended on the preparation of oral Zoletil®. The groups receiving Zoletil® as a dry powder reached the deepest stage of anaesthesia with both dosages after 30 min, whereas the groups receiving Zoletil® solution did not reach this stage before 60 min (Fig. 1). This interaction between administration form and anaesthesia time course was significant ($P < 0.02$).

Storage of the drugged bait had a highly significant effect on the depth of anaesthesia (Table 1). Anaesthesia was deeper for fresh baits ($P < 0.001$) at 30, 60, and 90 min after application compared to the depth reached after administration of the

Table 1. Stage of anaesthesia (mean ± SE) 30, 60, and 90 min after receiving oral Zoletil® (0 = no effect; 1 = light sedation; 2 = moderate sedation, close approach not possible; 3 = strong sedation, birds able to be handled by experienced people; 4 = superficial anaesthesia, birds able to be handled by inexperienced people; 5 = deep anaesthesia).

			Time After Application		
	N	Time[a]	30 min	60 min	90 min
40 mg/kg powder	10	0	3.0 ± 0.3	2.7 ± 0.4	2.7 ± 0.4
40 mg/kg solution	10	0	2.8 ± 0.4	3.1 ± 0.3	2.9 ± 0.4
80 mg/kg powder	9	0	3.8 ± 0.2	3.7 ± 0.2	3.6 ± 0.2
80 mg/kg solution	9	0	3.2 ± 0.3	3.9 ± 0.2	3.9 ± 0.2
80 mg/kg powder	9	7	1.8 ± 0.3	2.4 ± 0.3	1.8 ± 0.3
80 mg/kg powder	9	14	1.6 ± 0.3	2.1 ± 0.3	1.7 ± 0.3

[a] Storage time (hr).

drugged, stored bait. Mean (SE) depth of anaesthesia was highest 60 min after application with 2.4 and 2.1 for a storage time of 7 and 14 hr, respectively. Differences between 7 and 14 hr were not significant. All immobilized birds recovered completely. After 120 min of application, the depth of anaesthesia was <3 in all cases; the no effect level was reached after 5 hr in all except in four animals. These buzzards, two of them receiving 80 mg/kg Zoletil® solution and two 80 mg/kg Zoletil® in a powdered form, respectively, had an 8 hr recovery time before reaching stage 0.

Two birds died during this study. Both animals received 40 mg/kg Zoletil® as a solution. One died on the second day after the trial and one after a wk. The first bird showed massive edema of the mandibular space and intranuclear inclusions in renal tubular epithelial cells indicating a viral infection of the kidneys of an unknown origin. The second bird had an unremarkable recovery before it suddenly died seven days later. Necropsy of the bird showed severe arteriosclerosis, myocardial degeneration, cardiac insufficiency, and purulent hepatitis.

DISCUSSION

The combination of tiletamine and zolazepam has a wide safety margin and its use in birds is well documented (Schobert 1987, Blyde 1992, Hayes 1996). The depth of anaesthesia depends on the dose. Dose rates for intramuscular injection in birds range from 2 mg/kg in Common Rheas (*Rhea americana*) to 75 mg/kg in Green Herons (*Butorides virescens*) according to Schobert (1987). For buzzards, 14 mg/kg (Gray 1974) or 30 mg/kg (Trah 1990) were recommended. Giving Zoletil® orally seems to have a much wider safety margin according to our results. Therefore, there seems to be little risk for the life of non-target animals, which may accidentally feed on the bait, due to overdosing. However, in general birds were not in a stage of anaesthesia that would allow minor surgical procedures, even with a dose of 80 mg/kg. A possible explanation for this observation could be the fact that the breakdown of Zoletil® in the blood starts before the total absorption from the gastrointestinal tract has been completed.

The two deaths that occurred during the study were not a consequence of the experiment according to the post mortem findings. Any kind of anaesthesia induces a certain amount of considerable stress for each organism, which can lead to progression of preexisting diseases. This might have been the case in the first bird that died. However, 83% of the birds that received 80 mg/kg of the freshly-prepared bait, without storage time, were appropriately immobilized to allow inexperienced people to handle them safely (stage 4), whereas only 30% of the birds receiving 40 mg/kg reached that stage. Nevertheless, the dose of 40 mg/kg would be sufficient to enable handling of buzzards by experienced people, as 85% of the animals of that group reached at least stage 3.

Storage time of the drugged bait reduced the potency of the drugs. A major loss of drug effect occured in the first 7 hr, whereas in the next 7 hr the reduction of efficacy was less. Birds which are anaesthetized using a stored bait were sedated, but could not be handled by experienced people in all cases. Therefore, the drugged bait should be replaced after several hr if it is not taken by the bird. Although baits were force fed in this study, it is likely that birds will readily accept the prepared bait in one piece as previous experiences with different raptors have shown (H. Frey unpubl. data, M. Janovsky unpubl. data).

It is interesting to note that the form of the oral drug (i.e., powder or solution) had a significant effect on the time course of the anaesthesia. The groups receiving Zoletil® in a powdered form reached the deepest stage of anaesthesia after 30 min, whereas the groups receiving Zoletil® solution did not reach this stage before 60 min (Fig. 1). The reason for this phenomenon is not yet clear, but it seems possible that the liquid drug permeates into the bait, whereas, the powder stays on the surface allowing a quicker absorption.

Pain sensation in birds is comparable to that in mammals (Gentle 1992). Therefore, surgical procedures should not be carried out if only oral Zoletil® has been administered. In addition, the widespread used cyclohexamines like ketamine or tiletamine do not produce deep enough analgesia for surgical procedures in birds if used as a monoanaesthetic (Korbel 1998, Korbel et al. 1998). Thus we do not recommend surgery in birds which are immobilized with Zoletil® only. Although most birds recovered completely after 5 hr, full recovery took 8 hr in 4 animals. In practice, drugged birds should be kept isolated at minimum of 24 hr for complete recovery because absorption and metabolization rates vary individually.

We conclude that the oral application of liquid

or powdered Zoletil® in a dosage of 80 mg/kg is an appropriate method to immobilize Common Buzzards to enable safe handling. The safety margin of the drug combination at oral administration appears to be wide enough for use in capturing Common Buzzards of unknown mass.

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